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THE EFFECTS OF INTERTRIAL INTERVAL AND PROBLEM LENGTH
ON SUCCESSIVE SPATIAL REVERSAL LEARNING IN THE
MONGOLIAN GERBIL MERIONES UNGUICULATUS

by
Jeffrey Masors

A Thesis

Presented to the Graduate Committee
of Lehigh University
in Candidacy for the Degree of
Master of Science

in
Psychology

Lehigh University

1976

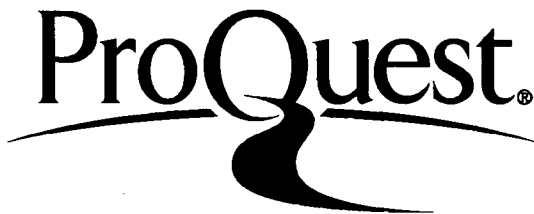
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This thesis is accepted and approved in partial fulfillment of the requirements for the degree of Master of Science.

March 15, 1976
(date)

____ Professor in Charge ____

Chairman of Department

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Abstract

The successive spatial reversal learning capability of the Mongolian gerbil Meriones unguiculatus was examined. A 2 X 2 factorial design, with seven gerbils in each group, was used to assess the effects of inter-trial interval (0 sec, 12 min) and problem length (4, 10 trials per problem) on performance in a successive spatial reversal learning task. Unlike previous reversal learning experiments with rodents, a modified Kay and Oldfield-Box apparatus was used to reduce exploratory behavior.

Three analyses of variance on three dependant variables were performed. The first analysis, on the number of correct responses per block of five problems, demonstrated the superiority of massed (0 sec ITI) practice over spaced (12 min) practice, $p < .05$, but no significant difference in performance was attributable to problem length, $p > .05$. A progressive improvement in reversal performance was demonstrated across, $p < .01$, and within, $p < .01$, problems. The second analysis, on the incidence of 1-trial reversals, demonstrated that more 1-trial reversals occurred during massed practice, $p < .05$, and problem lengths of 10 trials, $p < .05$. The third analysis, on the rate of alternation, demonstrated a greater alternation rate during massed

practice, $p < .01$, and during problem lengths of 10 trials, $p < .01$. There was a significant interaction between these two treatments, $p < .01$.

The results support the hypothesis that gerbil reversal learning is affected by the same factors that affect rat reversal learning. However, gerbil performance was inferior to rat performance under similar treatment conditions despite the reduction in exploratory behavior produced by the testing apparatus. Thus the proposition that rats learn reversals at the same rate as gerbils, but that gerbil performance is inferior to rat performance due to the gerbil's greater exploratory tendency was rejected. The ITI effect was explained in terms of an interaction between proactive interference and spontaneous alternation. Alternation aided the learning of reversals by increasing the tendency to respond to both stimuli, while proactive interference hindered reversal learning by facilitating response perseveration.

Introduction

Successive spatial reversal is a task used by numerous investigators to compare learning capabilities among species. In successive spatial reversal experiments the subjects learn a number of position discriminations, either for a fixed number of trials or to some criterion level of correct choice, in which the locus of reward is changed from problem to problem in an alternating sequence. Thus, if on problem one the left position is rewarded then on problem two the right position will be rewarded, and so on to the end of the experiment.

A progressive improvement in successive spatial reversal learning, a decrease in errors per problem, has not been demonstrated in any species less cortically developed than a reptile. Improvement has not been demonstrated in invertebrates such as the earthworm Lumbricus terrestris (Datta, 1962), the cockroach Nauphoeta cinerea (Longo, 1964), the Bermuda land crab Gecarcinus lateralis (Datta, Milstein, and Bitterman, 1960), and the sowbug Armadillidium vulgare (Thompson, 1957). Among the vertebrates, the African mouthbreeder Tilapia macrophila (Bitterman, Wodinsky, and Candland, 1958) and the paradise fish Macropodus opercularis (Warren, 1960) have failed to show improvement. The

painted turtle Chrysemys picta picta (Kirk and Bitterman, 1963), monotreme Tachyglossus aculeatus (Sanders, Chen, and Pridmore, 1971), white Cartreux pigeon (Bullock and Bitterman, 1962), Mongolian gerbil Meriones unguiculatus and hooded rat Rattus domesticus (Carey and Fischer, 1973), and Siamese cat and rhesus macaque monkey Macaca mulatta (Warren, 1966) have all shown improvement in successive spatial reversal learning, although to varying degrees of proficiency.

In an examination of spatial discrimination and reversal learning by gerbils and rats, Carey and Fischer (1973) found that the species did not differ in learning the spatial discrimination, but there was a species difference in performance on 15 successive spatial reversals. While both rats and gerbils improved on the reversal task, gerbils made more errors than rats. Given this difference in performance, are the factors affecting successive spatial reversal learning the same for both species?

Stretch, McGonigle, and Morton (1964) have examined the effects, on rats, of a 0 sec and 12 min intertrial interval (ITI) and 6, 8, and 10 trials per problem (TR/P) on 25 daily spatial reversals in a T-maze. The results demonstrated a progressive improvement for all groups, the superiority of massed (0 sec ITI) over

spaced (12 min ITI) practice, and the absence of any significant difference in performance due to problem length. Since gerbils and rats are both members of the order Rodentia one might expect the factors affecting learning in this situation to be the same for both species. Thus a short ITI would produce more correct choices than a long ITI, but the number of trials per reversal would have no significant effect on reversal learning by gerbils. The purpose of this study is to examine this prediction.

The apparatus used in this experiment was not a T-maze as in Stretch, et al. (1964). A modified version of the apparatus developed by Kay and Oldfield-Box (1963) for use in three-dimensional object discrimination problems with rats was adapted for use with gerbils. The apparatus was changed for two reasons. First, since this experiment is intended as the first in a series of experiments to examine the ability of gerbils to form various learning sets it was desirable to examine how gerbils perform in an apparatus more suitable for this task than a T-maze. Second, gerbils have a greater tendency to explore their environment than rats (Glickman and Hartz, 1964) which may affect the relative performance but not the learning capabilities of these species. The Kay and Oldfield-Box apparatus might limit

the number of errors due to exploratory behavior relative to a T-maze. The apparatus is less complex and has less floor space than a T-maze, factors which tend to increase the amount of exploratory behavior and consequently the number of errors due to exploration.

A number of studies comparing gerbil and rat behavior in various learning situations support the idea that how well gerbils perform relative to rats may depend on the gerbil's greater tendency to explore. Gerbil performance in tasks hindered by exploration, e.g., brightness discrimination (Wise and Parker, 1968), passive avoidance (Lippman, Galosy, and Thompson, 1970), and successive spatial reversals (Carey and Fischer, 1973), is inferior to rat performance. On the other hand, gerbil performance in tasks aided by exploration, e.g., signaled (Ashe and McCain, 1972) and unsignaled (Powell, 1972) active avoidance, is superior to rat performance.

Two hypotheses were tested in this study. First, gerbil performance on a successive spatial reversal task would be affected by the ITI, a short ITI producing performance superior to a long ITI, and would not be affected by problem length, as in rats. Second, improvement in performance by gerbils would be equal, or slightly inferior to the improvement in performance by rats in a T-maze.

The second hypothesis rests on a number of assumptions. First, since gerbils tend to explore their environment more than rats, an apparatus which reduces gerbil exploratory behavior below that which occurs in a T-maze should provide a more accurate measure of the gerbil's learning capability relative to the rat. Second, the Kay and Oldfield-Box apparatus used in the present experiment is such an apparatus. And third, both species are equally capable of learning the reversal task.

Method

Subjects

The subjects were 29 male, experimentally naive Mongolian gerbils Meriones unguiculatus obtained from Tumblebrook Farm, Inc., Tum:(MON)¹. The animals were 13 weeks old at the start of the experiment. They were housed three or four to a 25 cm by 46 cm white plastic cage with a 12 hr light-dark cycle (LD 12:12). The gerbils were maintained on a 22 hr food deprivation schedule and were hopper fed in their home cages within 30 min after training. The experiment was run during the light cycle in the same room in which the gerbils were housed.

Apparatus

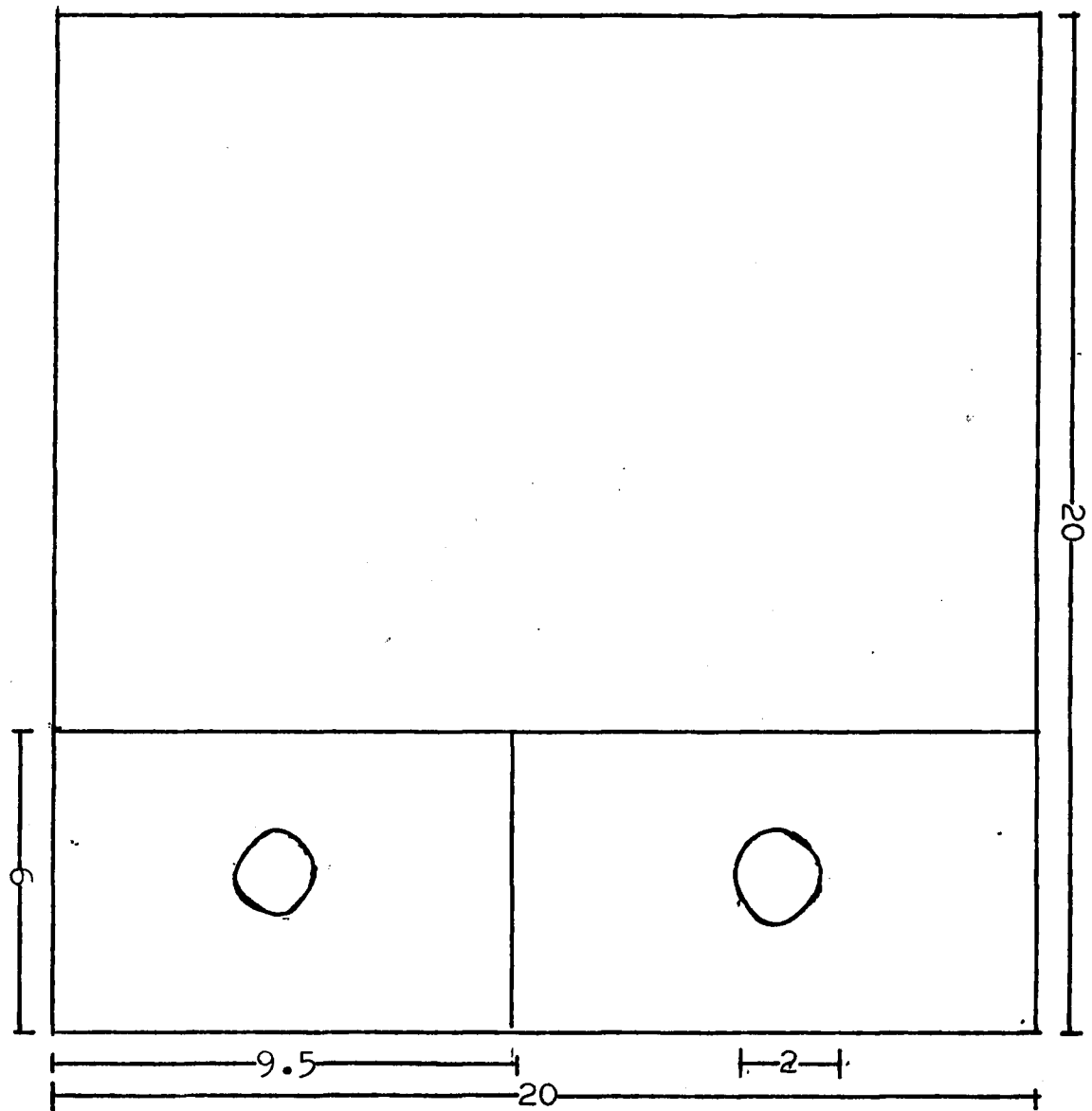
The apparatus was a wooden box, 20 cm by 20 cm by

18 cm high. At one end were two apertures, each 9.5 cm by 6 cm. A 2 cm diameter foodwell was placed in the center of each aperture and covered by a 3 cm square block (see Figure 1). Under the foodwells, inaccessible to the animals, were sunflower seeds to control for olfactory cues. Two screens divided each aperture from the rest of the box. A transparent screen allowed the gerbils to see each aperture but prevented any approach until the screens were raised; an opaque screen prevented the gerbils from observing the replacement of the reward - one sunflower seed. The inside of the apparatus, with the exception of the white opaque screens, foodwells, and wooden blocks, was painted black as in Kay and Oldfield-Box (1963).

Procedure

Pretraining. All animals were adapted to the deprivation schedule for five days. The gerbils were then trained to eat sunflower seeds from the foodwells and to displace the blocks from over the foodwells and obtain the reward. Both foodwells were filled with sunflower seeds for two days during which each gerbil was allowed 10 min to eat the seeds. On the third day, training with a stimulus shape began. While the screens were lowered, a seed was placed in one foodwell with the stimulus shape, a block, in back of the foodwell.

Figure 1
Apparatus dimensions (cm).



The screens were then raised and the gerbil was allowed to obtain the reward. If the animal obtained the reward in 10 sec, the block was placed partially over the foodwell on the next trial. On subsequent trials, if the animal displaced the block and obtained the reward in 10 sec, the block was placed further over the foodwell. On each trial, the screens were lowered after the animal had obtained the reward or after 10 sec if the animal failed to make the proper response, thus forcing him to leave the aperture. The baited foodwell was varied randomly from trial to trial. One gerbil was dropped from the experiment at this point for failing to learn the displacement task.

Once the block fully covered the foodwell and the animal had displaced the block and obtained the reward in 10 sec for 9 out of 10 consecutive trials, individual position preferences were determined. Ten practice trials were given with both foodwells baited to determine position preferences. All gerbils showed a position preference. The gerbils were then assigned at random to the four treatment groups.

Training. A 2 X 2 factorial design was used with 4 and 10 TR/P and average ITIs of 10 sec and 12 min. Use of the Kay and Oldfield-Box apparatus necessitated a change in the 0 sec ITI value used by Stretch, et

al. (1964). A 0 sec ITI is physically impossible in the Kay and Oldfield-Box apparatus. Instead, the shortest possible ITI was used - 10 sec. Each animal received a total of 25 problems, one position discrimination problem and 24 reversal problems, one problem per day.

On Problem 1, all animals were run against their position preference. During each trial the correct foodwell was baited, the blocks were placed in position and the opaque screens were raised. After an inspection period of five sec the transparent screens were raised and the gerbil was allowed to respond. After the gerbil had displaced the block, and obtained the seed if correct, the screens were lowered and the animal was detained outside the apertures for the appropriate ITI. If correct, the gerbil ate the seed outside the aperture, usually within three sec. A noncorrection procedure was used. An incorrect response was recorded if the block covering the unbaited foodwell was displaced.

Two daily running procedures were used. Animals in the 10 sec ITI condition were run sequentially. Thus, one gerbil was given one problem, then the next gerbil was given one problem, and so on until all the gerbils in this condition were run. Due to time constraints, animals in the 12 min ITI condition were run concurrently. Thus, all the gerbils in a group (4 or 10 TR/P) were

given trial one before any of the gerbils in that group were given trial two. This procedure was repeated for each trial. To reduce the effects of handling, each gerbil remained in a separate apparatus during the running of the one daily problem.

Results

Since the 10 TR/P condition received 10 trials on each problem while the 4 TR/P condition received only 4 trials on each problem, the unit of measurement adopted was the number of correct responses on Trials 1 through 4 of a block of five problems. Figure 2 shows the mean percentage of correct responses for each experimental condition as a function of problem blocks.

A factorial analysis of variance was performed on the data from Trials 1 through 4. An improvement in reversal performance occurred across problem blocks, $F(4, 96)=3.95$, $p<.01$, and within problems, $F(3, 72)=9.96$, $p<.01$. The main effect of ITI was significant, $F(1, 24)=7.17$, $p<.05$, demonstrating the superiority of massed (10 sec ITI) over spaced (12 min ITI) practice. There was a significant interaction between ITI and within problem performance, $F(3, 72)=4.03$, $p<.05$, as shown in Figure 3. Massed practice apparently produced greater within problem learning than did spaced practice. No other treatment effect or interaction was significant at the .05

Figure 2

Mean percentage of correct responses on Trials 1 - 4
for each treatment in blocks of five problems.

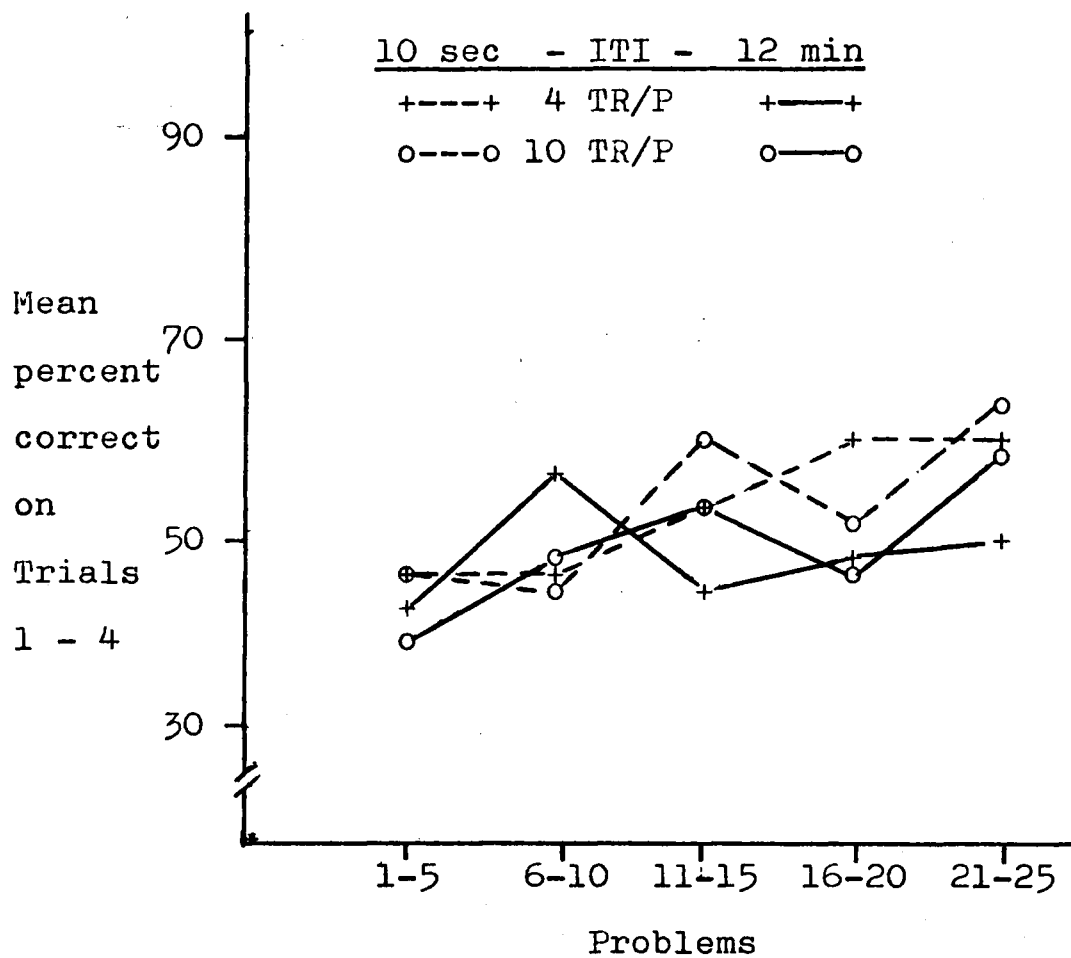
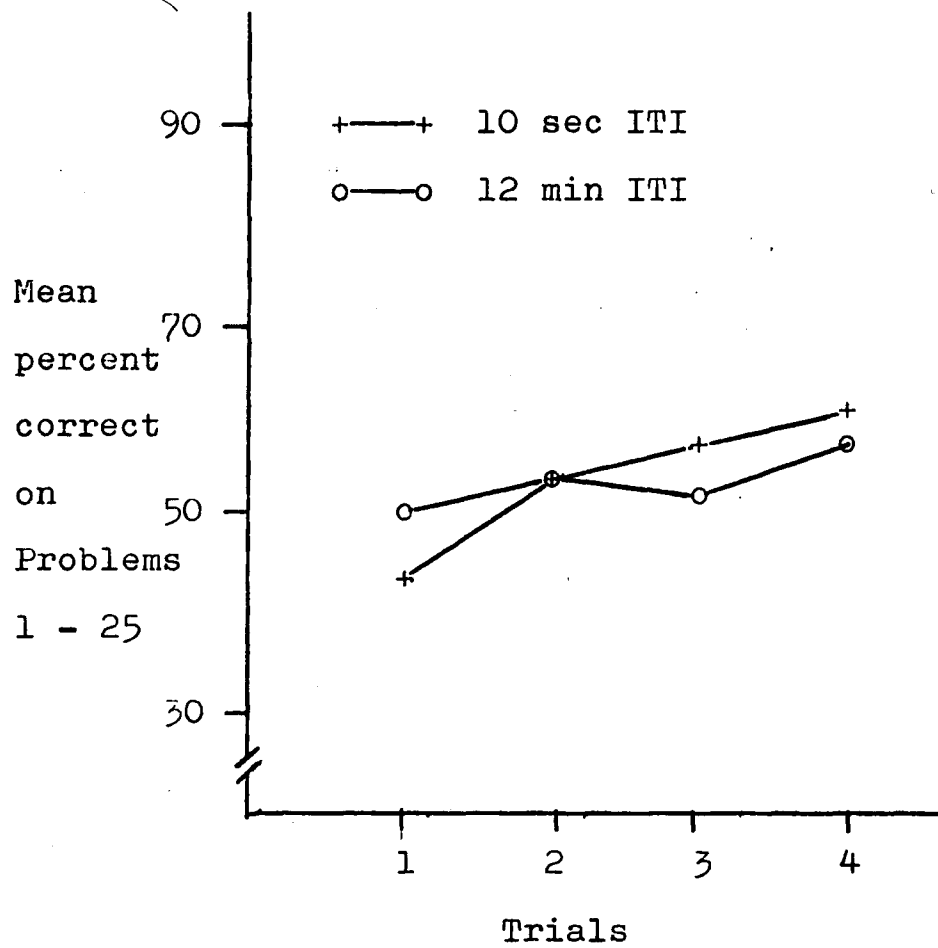


Figure 3

Mean percentage of correct responses on Trials
1 - 4 during Problems 1 - 25 for each ITI condition.



level.

If, as in Figure 4, the data are plotted in learning set form, i.e. the mean percentage of correct responses per trial for blocks of five problems, the superiority of massed over spaced practice is again evident as is the greater within problem learning for massed practice.

An analysis of variance was performed on the 10 TR/P groups alone to examine performance through Trial 10. As with the analysis of the first four trials, the superiority of massed over spaced practice was evident, $F(1, 12)=53.04$, $p<.01$. An improvement in performance across, $F(4, 48)=69.46$, $p<.01$, and within, $F(9, 108)=13.70$, $p<.01$, problems was evident. There was a significant interaction between ITI and within problem performance, $F(9, 108)=3.07$, $p<.05$. Massed practice produced a greater rate of improvement in reversal performance within problems than did spaced practice (see Figure 5). Thus, the processes affecting performance during Trials 1 - 4 alone, affect performance during Trials 1 - 10 in the same manner.

Previous investigators of rodent position reversal learning (Pubols, 1957, Stretch, McGonigle, and Rodger, 1963, Stretch, McGonigle, and Morton, 1964) have regarded the incidence of 1-trial reversals as one index of position reversal learning set attainment. A 1-trial

Figure 4

Mean percentage of correct responses per trial for
blocks of five problems for ITI conditions.

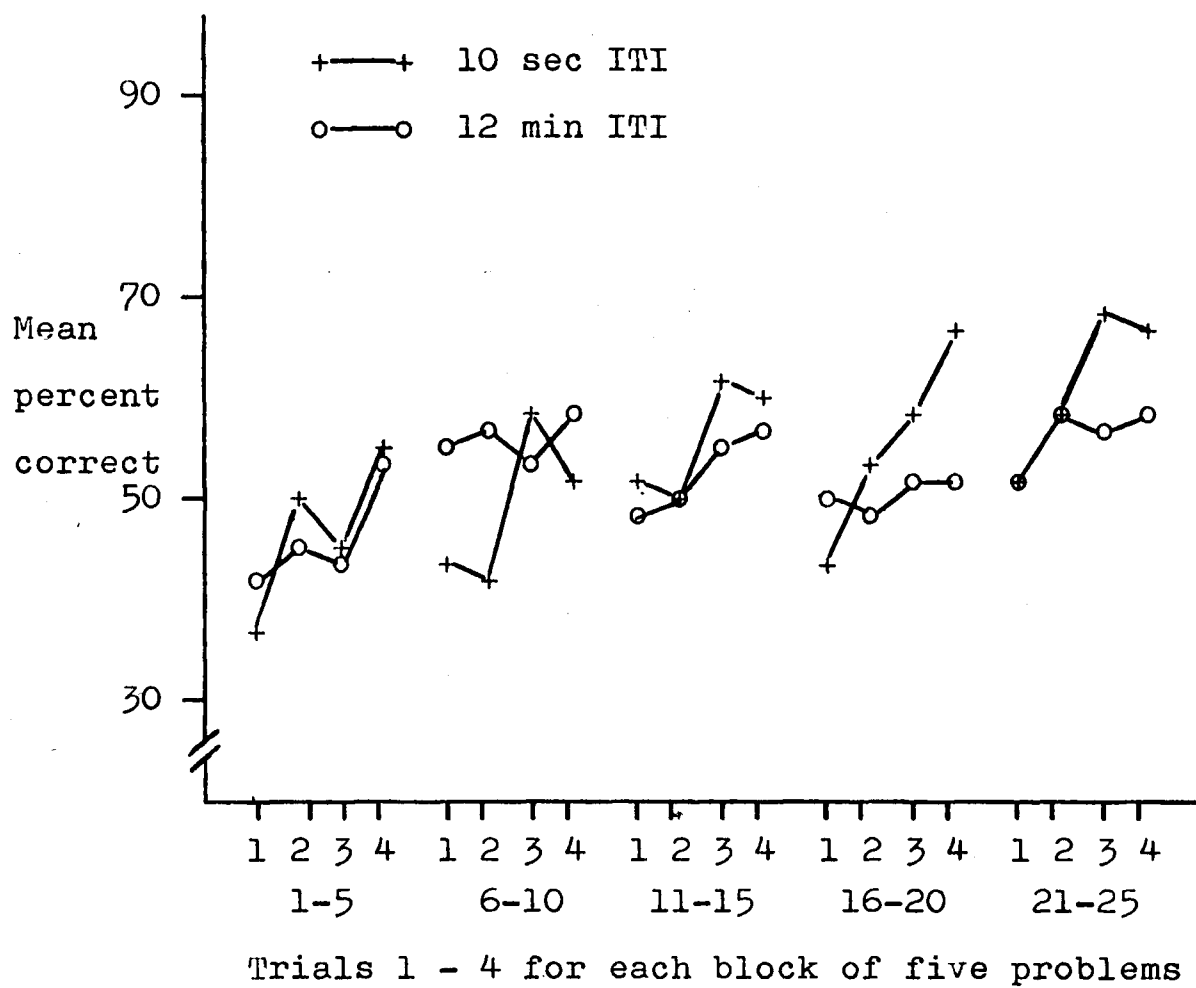
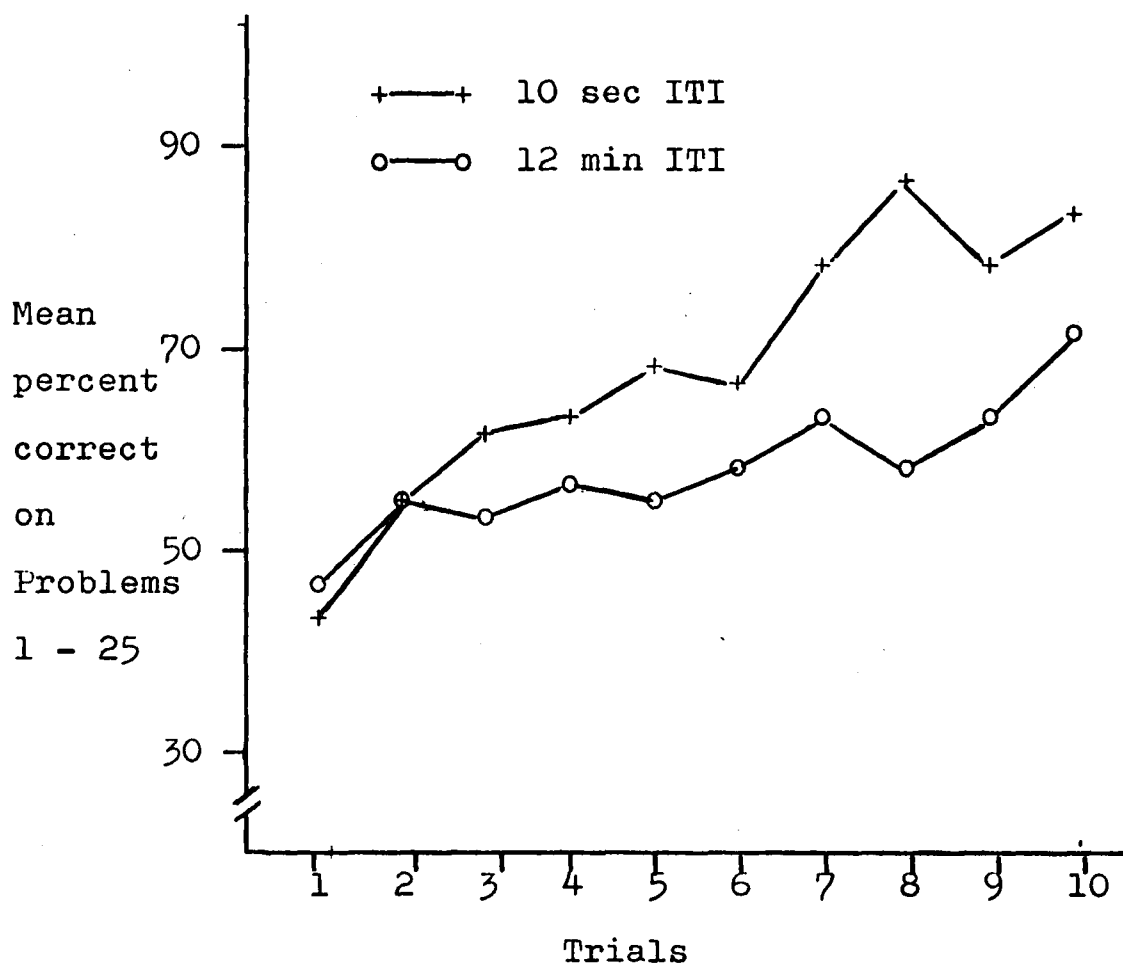


Figure 5

Mean percentage of correct responses by the 10 TR/P groups on Trials 1 - 10 during Problems 1 - 25 for each ITI condition.



reversal is said to have occurred if an animal responds incorrectly on Trial 1 of a new problem but responds correctly on all subsequent trials of that problem (-++ +). An analysis of variance on the first four trials per problem block was performed to examine the incidence of 1-trial reversals. More 1-trial reversals were performed during massed practice than during spaced practice, $F(1, 24)=5.19$, $p<.05$. The incidence of 1-trial reversals was greater for the 10 TR/P condition than for the 4 TR/P condition, $F(1, 24)=5.44$, $p<.05$. However, there was no significant change in 1-trial reversal incidence over problem blocks, $F(4, 96)=1.00$, $p>.05$.

Since alternation may be a factor affecting reversal learning (Clayton, 1966) an analysis of variance was performed to examine the incidence of alternation in the first four trials of each problem. Alternation was defined as the choice on one trial of the alternative opposite that chosen on the preceding trial. There was a greater tendency to alternate during massed practice than during spaced practice, $F(1, 24)=46.98$, $p<.01$, and a greater number of alternations for the 10 TR/P condition than the 4 TR/P condition, $F(1, 24)=16.57$, $p<.01$. The interaction of these two effects was significant, $F(1, 24)=11.84$, $p<.01$. While massed practice had little effect on alternation across problem length, spaced prac-

tice suppressed alternation more so during problems with 4 trials than problems with 10 trials (see Figure 6).

It should be noted that the last two analyses (1-trial reversals, and alternation) were decided upon after the data had been collected. Thus the statistical significance of the analyses is questionable.

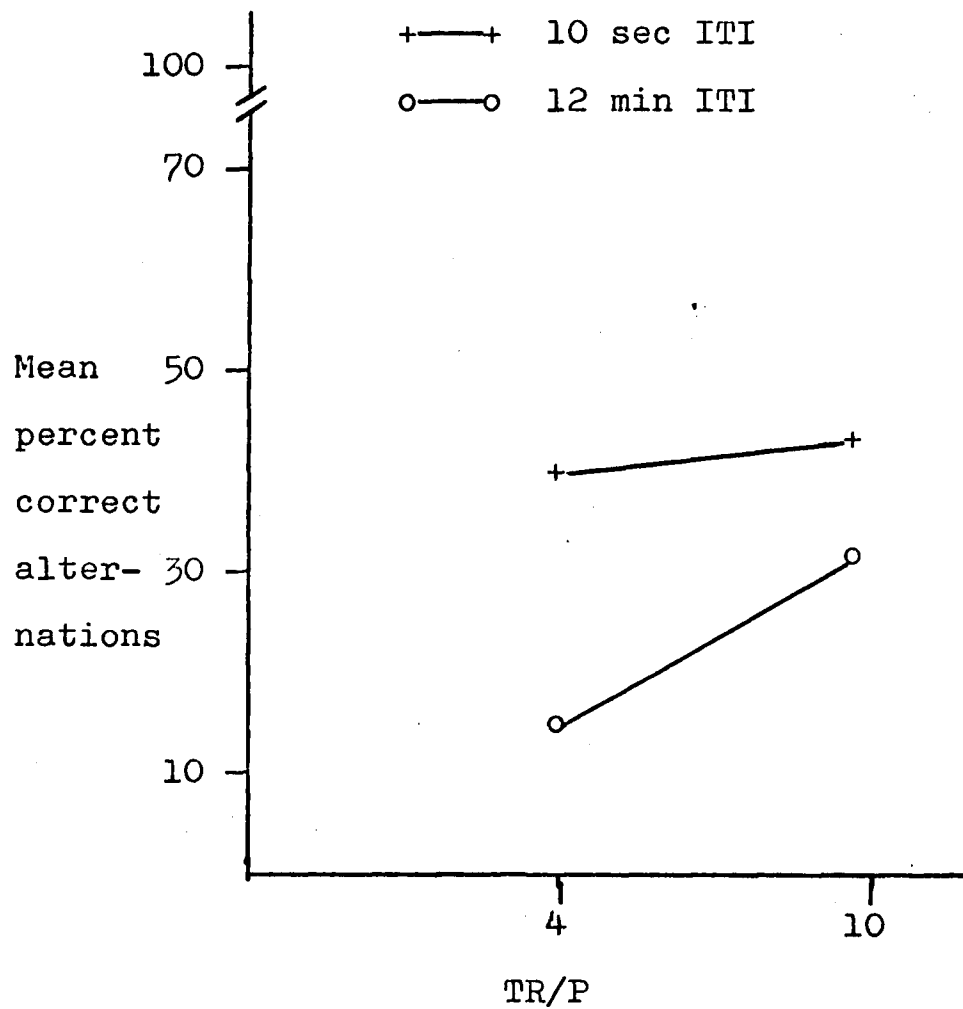
Discussion

The results of the present experiment support the hypothesis that ITI affects successive spatial reversal learning by gerbils, whereas problem length, at least within the limits of the present experiment, does not influence reversal learning. The hypothesized direction of effect for ITI is also supported; massed practice produced a greater number of correct responses per reversal than did spaced practice.

The ITI effect may be due to an interaction between spontaneous alternation and forgetting (Clayton, 1966). Spontaneous alternation refers to the organism's tendency not to repeat the response previously made. This would affect performance deleteriously, within problems, if the more probable response was the correct response because the tendency to alternate would increase the number of errors. Performance across reversal problems would be enhanced by this tendency since the more probable response would be the previously rewarded, and now

Figure 6

Mean percentage of alternations on Trials 1 - 4 of
Problems 1 - 25 for each ITI condition.



incorrect, response. Dember and Fowler (1958) have established that alternation, in rats, decreases as ITI increases, hence alternation should have less effect on performance during a long ITI.

On the other hand, performance should deteriorate as ITI increases due to forgetting. A proactive interference explanation of forgetting would explain a performance decrement as primarily due to the spontaneous recovery of previous response tendencies during the ITI. If the probability of recovery increases with time, then the longer the ITI, the greater the probability of interference. Thus, within and across problems, reversal learning would deteriorate with long ITIs due to response perseveration produced by proactive interference.

Hence, animals that learn the reversal task should demonstrate alternation; animals that do not learn the reversal task should demonstrate response perseveration. Further, since reversal learning necessitates a decrease in alternation within a problem, animals receiving a 10 sec ITI should show a decrease in alternation across and within problems, while animals receiving a 12 min ITI should demonstrate response perseveration throughout training.

The first prediction is supported by the data analysis. Those animals demonstrating reversal learning,

animals in the 10 sec ITI condition, indicated a greater tendency to alternate than did those animals not demonstrating reversal learning, animals in the 12 min ITI condition. Evidence for the second prediction is not as clear. The second prediction requires that animals in the 10 sec ITI condition demonstrate a decrease in alternation across and within problems while animals in the 12 min ITI condition demonstrate no change in alternation. In other words, ITI by Problem, ITI by Trial, and ITI by Problem by Trial interactions would be evidence for the validity of the second prediction. However, these interactions are not significant at the .05 level². In fact, there is no evidence, i.e., statistical significance, for any change in alternation.

The lack of these interactions and the absence of a change in alternation across problems would seem to argue against an alternation-forgetting explanation of the ITI effect. However, the second prediction requires that the gerbils achieve a high level of performance in the reversal task, i.e., asymptotic performance on Trial 2 of a problem, for alternation to decrease across and within problems; the first prediction only requires a moderate level of performance relative to gerbils not demonstrating a performance improvement in the reversal task. After 25 problems, the gerbils in the 10 sec ITI condition were performing

at a correct response rate only slightly above chance on Trial 2.

Consequently, one might argue that the second prediction is not relevant to the present experiment since only a moderate performance improvement in the reversal task was attained in the 10 sec ITI condition. If the gerbils in the present study had demonstrated a high level of performance in the reversal task and still failed to demonstrate the appropriate interactions one could discount the alternation-forgetting explanation of the ITI effect. Thus, absence of the appropriate interactions is not evidence against the alternation-forgetting hypothesis.

Further support for the role of alternation in successive reversal learning is given by a comparison of alternation tendency with proficiency in the reversal task. As final performance decreases in Figure 2, so does alternation in Figure 6. The 10 sec ITI condition produced little response perseveration and a correspondingly small difference in alternation tendencies for different problem lengths. While the 12 min ITI condition produced substantial response perseveration, the greater amount of practice allowed by the 10 TR/P condition produced a more rapid reduction in response perseveration than in the 4 TR/P condition thereby increasing

alternation and producing an ITI and problem length interaction. In summary, alternation might aid reversal learning by allowing the organism to repeatedly change (reverse) its response, while response perseveration, produced by proactive interference, might deter reversal learning by preventing the organism from changing its response.

Given that gerbils can learn a successive spatial reversal task and that performance is affected by ITI, but not problem length, how does gerbil performance compare to rat performance in a similar task? It was hypothesized that the factors affecting rat performance would be the same as those factors affecting gerbil performance, and that performance in the Kay and Oldfield-Box apparatus would produce a learning rate in the gerbil equivalent or slightly inferior to that of the rat in a T-maze. The data seem to support the first half of the hypothesis - similar learning processes - but not the second half - equivalent learning rates.

Improvement on a successive spatial reversal task by rats is affected by the ITI but not by problem length. The same is true for the gerbils in the present experiment. Further, the ITI effect was in the same direction for both species, spaced practice produced poorer performance on the task than did massed practice. Con-

sequently, successive spatial reversal learning is affected by some of the same processes in rats as in gerbils.

While gerbil and rat performance on the task may be affected by the same factors, overall performance by rats is superior to performance by gerbils. A comparison of the mean percentage of correct responses per problem block between Stretch, et al. (1964) and the present experiment demonstrates the superiority of rat performance. The poorest group performance in Stretch, et al. (1964) - 45% correct on the first five problems to 70% correct on Problems 20 - 25 for the 6 TR/P, 12 min ITI condition - was superior to the best group performance in the present experiment - 45% correct on the first five problems to 60% correct on Problems 20 - 25 for the 10 TR/P, 10 sec ITI condition.

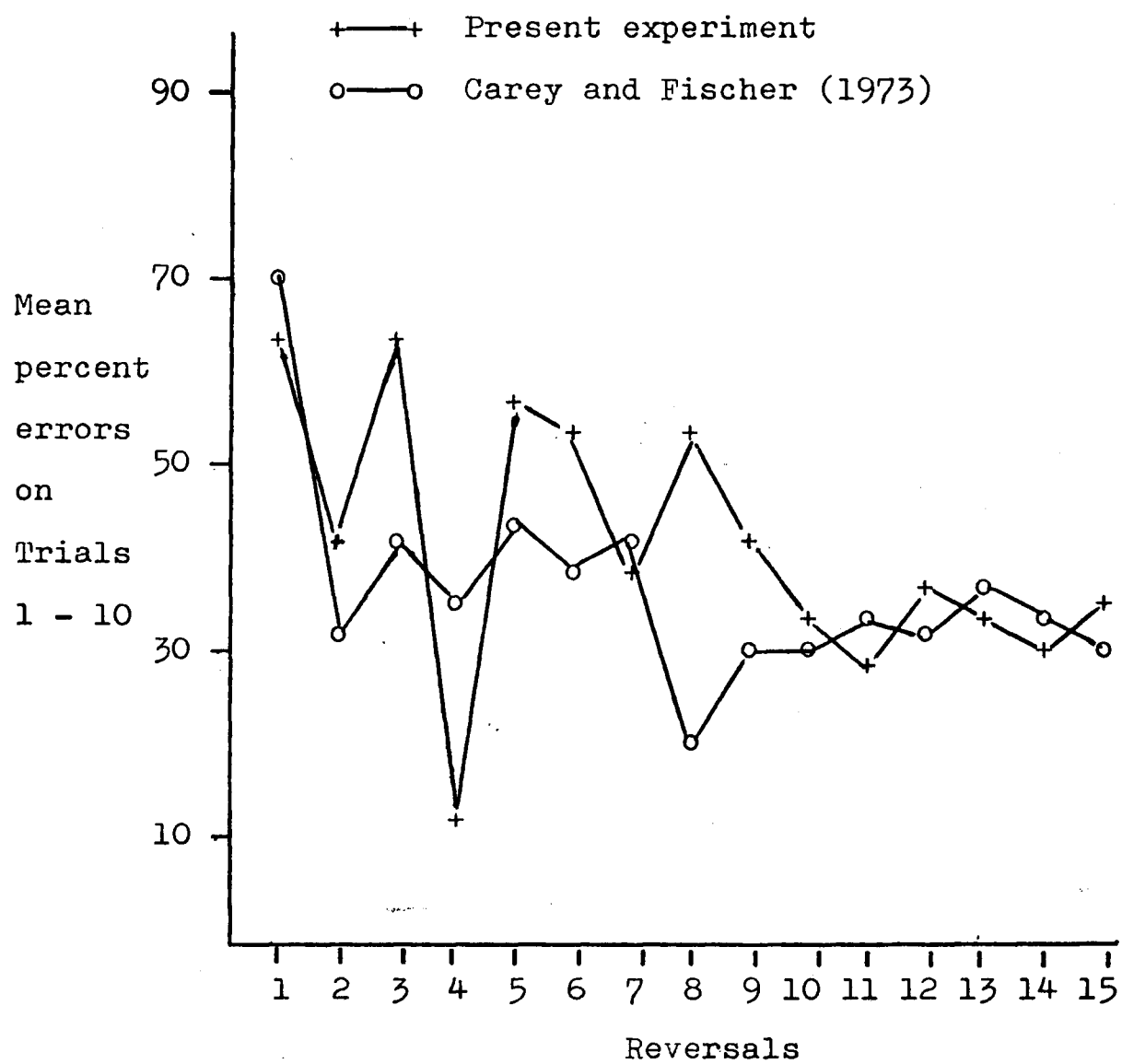
This result is in agreement with Carey and Fischer (1973). After 15 daily reversals, 10 TR/P with a 3 min ITI, the gerbils were performing at a rate of three errors per reversal, while the rats were performing at a rate of two errors per reversal. If the performance of the gerbils in the present experiment receiving 10 TR/P with a 10 sec. ITI is plotted by percent errors for the first 15 reversals (Problems 2 - 16) a similar decrease in errors is found as in Carey and Fischer (1973).

Gerbils in the present experiment appear to be performing with an error rate equivalent to the gerbils in Carey and Fischer (1973) (see Figure 7).

Taken together these findings seem to indicate a species difference in successive spatial reversal learning and not a performance difference attributable to the apparatus. Clayton (1966) notes that reversal learning by rats does not significantly differ for 10 sec and 3 min ITIs. Since ITI has been shown to affect reversal learning in the same manner for gerbils and rats, for the values tested, it is not unreasonable to assume that this relationship would hold at other ITIs. It should be noted that this is a testable assumption and that the validity of the following discussion rests on that test. However, given this assumption, one might argue that gerbil performance on a reversal task will not differ for ITIs of 10 sec and 3 min. If this is true, then performance by the Carey and Fischer gerbils should not be significantly different from performance in the present experiment of gerbils receiving 10 TR/P with a 10 sec ITI if there are no differential apparatus effects. In other words, reversal learning by gerbils in a T-maze might not be any different from reversal learning in a Kay and Oldfield-Box apparatus despite the probable reduction in exploratory tendency produced by the appa-

Figure 7

Mean percentage of errors on 15 successive spatial reversals by gerbils in the present experiment and Carey and Fischer (1973).



tus. Thus, performance similarities between the present experiment and Carey and Fischer (1973) and performance differences between the present experiment and Stretch, et al. (1964) might be due to species differences in learning capabilities, not apparatus differences.

This reasoning also casts doubt on the Carey and Fischer supposition that gerbils do poorly in reversal learning situations, as compared to rats, due to a greater exploratory tendency. The exploratory activity of the gerbils in the present experiment, given massed practice in the Kay and Oldfield-Box apparatus, seemed to be less than the exploratory activity of gerbils in a T-maze as described by Carey and Fischer (1973). Rather than wander around in the box between trials, the gerbils remained in front of one screen. When the screens were raised, the animals immediately displaced a block and then retreated from the aperture. Gerbil performance in a T-maze is quite different. Gerbils tend to wander through the maze rather than proceeding directly to the goal box.

If the Carey and Fischer hypothesis is correct, performance in an apparatus that reduces exploratory activity should enhance reversal learning by gerbils. Hence, the gerbils in the present experiment should have

a lower error rate than the gerbils in Carey and Fischer. However, there does not appear to be any difference in error rates in the two situations. Thus, exploration apparently does not account for performance differences between rats and gerbils during reversal learning.

One other difference between the gerbils in the present experiment and the rats in Stretch, et al. (1964) remains to be discussed - learning set attainment. A learning set was formed by both species since both species showed progressive improvement across problems. However, the rats apparently formed a position reversal learning set, i.e. a position win - stay; lose - shift hypothesis, while the gerbils did not form such a hypothesis. This difference is evidenced in the number of 1-trial reversals performed. In Stretch, et al. (1964) all 30 rats performed at least one 1-trial reversal, while only 20 out of 28 gerbils performed at least one 1-trial reversal. Another indication of this difference is that the rats were able to attain asymptotic performance on Trial 2 by the end of training while the gerbils never attained such proficiency. Thus, only the rats were able to form a position win - stay; lose - shift hypothesis within 25 problems. It should be noted that while the gerbils did not form the correct hypothesis they are not incapable of hypothesis formation. Blass

and Rollin (1969) have demonstrated the formation of an object discrimination learning set in gerbils, indicating that gerbils can form hypotheses. Thus, with more problems the gerbils might form a position win - stay; lose - shift hypothesis.

One-trial reversal performance by the gerbils in this experiment was anomalous. There was no significant increase in 1-trial reversals over problems but the occurrence of 1-trial reversals was significantly affected by ITI and problem length. This result is anomalous because 1-trial reversals, as a measure of position reversal learning set, should not be present early in training and should increase with an increase in learning. Consequently, if 1-trial reversals occur, their occurrence should be related to the amount of training and other factors which affect learning. However, 1-trial reversals were performed at a constant, low rate throughout training, yet there were significant differences in their occurrence due to ITI and problem length. In other words, factors affecting learning affected 1-trial reversal occurrence but no learning of 1-trial reversals occurred.

Footnotes

1. ILAR Committee on Nomenclature outbred strain designation for Meriones unguiculatus produced by Tumblebrook Farm, Inc.
2. A factorial analysis of variance was performed to examine alternation on Trials 2 through 4 in blocks of five problems. The 10 sec ITI condition produced more alternation than the 12 min ITI condition, $F(1,24)=42.66$, $p<.01$. The 10 TR/P condition produced more alternation than the 4 TR/P condition, $F(1,24)=33.71$, $p<.01$. There was no change in alternation across, $F(4,96)<1$, $p>.05$, and within, $F(2,48)<1$, $p>.05$, problems. The following interactions were significant: ITI by Problem, $F(4,96)=2.61$, $p<.05$; ITI by TR/P, $F(1,24)=10.9$, $p<.01$; TR/P by Problem, $F(4,96)=8.16$, $p<.01$; Problem by Trial, $F(8,192)=5.56$, $p<.01$; and ITI by TR/P by Problem, $F(4,96)=4.85$, $p<.01$.

While some of these results support the alternation-forgetting hypothesis, this analysis should not be used to argue for the hypothesis and its predictions due to the post hoc nature of the analysis. Although the same argument might be applied to the initial alternation analysis it should be noted that the present analysis was performed after the results from the initial analysis had been examined. Consequently,

arguments based on the initial series of post hoc analyses (alternation and 1-trial reversals) should be treated as hypotheses, at best, while arguments based on the present analysis would seem to be too weak to even be termed hypotheses.

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Vita

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